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ABSTRACT

In order to test the hypothesis that bizarre imagery can be an effective mnemonic aid with delayed testing, a context of mixed materials, and an adequate stimulus presentation pace, a study examined 40 undergraduates who were randomly presented with three paired-associate lists (normal, bizarre, and mixed). Within each list the sentences consisted of stimulus-response pairs of high-imagery nouns. Twenty subjects participated in an immediate cued recall condition for each list while the remaining 20 were tested after a 1-week retention interval. Subjects were further subdivided depending upon whether the presentation pace was forced or not. Results indicated that bizarre imagery would seem to be an effective mnemonic aid on immediate recall when materials are mixed and when the pacing is self-controlled. However, if long-term retention is required, the learning context is the important factor on performance. (A table of the mean number of correct terms recalled as a function of context, delay, and presentation pace is included, and 28 references are appended.) (MM)

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Bizarre Mnemonic Aids on
Paired Associate Retention as a Function of
Context, Delay, and Presentation Pace
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Running head: BIZARRE MNEMONICS

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Abstract

Recent findings have indicated that bizarre imagery can be an effective mnemonic aid with delayed testing, a context of mixed materials, and an adequate stimulus presentation pace. We therefore hypothesized an interaction among all three variables. Using the Iaccino, Dvorak, and Coler (1988) methodology, forty undergraduates were each randomly presented with three paired-associate lists (i.e., normal, bizarre, and mixed). The sentences within each list consisted of stimulus-response pairs of high-imagery nouns. Twenty of these subjects participated in an immediate cued recall condition for each list while the remaining number was tested after a one-week retention interval. Subjects were further subdivided depending on whether the presentation pace was forced or not. As predicted, a three-way interaction was found, with bizarre imagery benefitting immediate recall under a combined mixed context, self-paced condition; with delayed recall, however, context was the determining factor in performance (and not presentation pace).

Bizarre Mnemonic Aids on
Paired Associate Retention as a Function of
Context, Delay, and Presentation Pace

For centuries, people have inherently believed that unusual, strange, and often times implausible relations between stimulus elements have aided in the retrieval of those items at a later point in time (e.g., the CHIMP hung himself with a ROPE in the CAGE). In the research literature, however, the mnemonic effectiveness of bizarre imagery on recall has been questionable. Some experimenters have found that bizarre noun pairs did not exert a significant effect on immediate recall over more commonplace, interactive scenes (e.g., the CHIMP swung from the ROPE in the CAGE) that were employed (Cox & Wollen, 1981; Hauck, Walsh, & Kroll, 1976; Nappe & Wollen, 1973; Senter & Hoffman, 1976; Wollen, Weber, & Lowry, 1972; Wood, 1967). Other researchers surprisingly discovered that retention was adversely affected by the "too unusual" relationships (as cited in Adams, 1980; Collyer, Jonides, & Bevan, 1972; Emmerich & Ackerman, 1979; Wollen & Cox, 1981b). More recently, other variables have been examined along with bizarreness, one being the length of the

retention interval before recall. Iaccino and Spirek (1988), among others (Andreoff & Yarmey, 1976; Delin, 1968; Iaccino & Byrnes, 1985; Iaccino, Dvorak, & Coler, 1988; Marshall, Nau, & Chandler, 1980; Merry, 1980; Merry & Graham, 1978; O'Brien & Wolford, 1982; Webber & Marshall, 1978; Wollen & Cox, 1981a) found that when unexpected recall was delayed by a number of days or weeks, subjects were able to retain a significantly greater number of bizarre materials than normal. It was suggested by O'Brien and Wolford (1982) that subjects' memory traces for bizarre elements were less likely to be confused with other mundane information acquired during the delay period. Based on our extensive research, we further state that traces for more normal items degrade faster over time due to these other highly commonplace events (e.g., schoolwork, job assignments, athletic events, even sleep) interfering with the to-be-recalled material and eventually becoming the more dominant memories. A related finding is that bizarre images, on the average, take longer to form than normal ones and are rated as less vivid (see Collyer et al., 1972; Hauck et al., 1976; Iaccino & Byrnes, 1985; Iaccino, Dvorak, & Coler, 1988; McDaniel

& Einstein, 1986; Nappe & Wollen, 1973; Kroll, Schepeler, & Angin, 1986), highlighting the fact that time is necessary not only to process the "strange" input but also to consolidate it in long-term memory. Otherwise, the effectiveness of bizarre imagery as a mnemonic aid diminishes (as Jacoby, Craik, & Begg, 1979 as well as Zacks, Hasher, Sanft, & Rose, 1983 infer).

Beside time, the context in which the bizarre material is embedded can contribute to its more durable encoding. McDaniel and Einstein (1986) consistently discovered in their series of five experiments that bizarre imagery had a facilitative effect on immediate recall only when the stimulus lists contained both normal and bizarre elements (i.e., a mixed condition) as opposed to the standard unmixed lists. Moreover, this effect was reliably obtained in research recently conducted by our team (Iaccino, Dvorak, & Coler, 1988) where context and delay were manipulated. As Jacoby and Craik (1979) and others (Hunt & Elliott, 1980; Lockhart, Craik, & Jacoby, 1976) have argued, unusual elements become more distinctive (i.e., more unusual) when they are presented in surrounding contexts which are dissimilar and more

commonplace. It would appear that this stimulus distinctiveness theory could also account for the O'Brien and Wolford (1982) results with delayed testing where portions of the retention intervals supposedly contained commonplace events that clearly offset the bizarre elements. Therefore, depending on the context, bizarre imagery will either improve recall or not significantly affect the retention of these items.

The pace at which the stimulus materials were shown was also investigated with bizarreness, with the results yielding somewhat confusing trends. Some researchers (McDaniel & Einstein, 1986) discovered that it did not matter whether the stimulus presentation was self-paced or experimenter-paced (e.g., 7-, 8.5-, and 14-second rates); the mixed context effect was still evidenced. We (Iaccino, Dvorak, & Coler, 1988), on the other hand, employed a faster experimental pace of 4-seconds and found the context effect only under delayed testing. It might be that our interval was too short a time for subjects to process the inputs adequately and subsequently show immediate gains, whereas the McDaniel and Einstein (1986) rates of 7-seconds and beyond were of a sufficient duration for

subjects to benefit from a mixed context immediately.

The present experiment was, therefore, designed to investigate the interactive effects of these variables (i.e., presentation pace, context, and time of testing) on the recall performance of bizarre items. Using a variation of the McDaniel and Einstein (1986) methodology, we formulated the following hypotheses: 1) materials in the mixed context condition would be recalled the best under immediate and one-week delayed recall, provided subjects could process the stimuli at their own pace while 2) materials in the unmixed bizarre list would generate comparable recall to (if not worse recall than) unmixed normal items at both test periods, especially under the more rapid presentation pace of 4-seconds.

Method

Subjects and Design

The subjects were 40 undergraduate students of Illinois Benedictine College in Lisle, Illinois who received extra-credit points in Introduction to Psychology and Learning-Cognition laboratory courses for their voluntary participation. Twenty of the subjects were tested immediately while the remaining

number was tested after a one-week retention interval. These subjects were further subdivided ($n_s = 10$) depending on whether the presentation pace was forced or not. A mixed factorial design subsequently assessed the number of nouns correctly recalled in each of the paired-associate lists, with presentation pace (experimenter, subject) and delay (3-minute, 1-week) representing the between-subject factors and context (unmixed normal, unmixed bizarre, and mixed) the within-subjects factor.

Stimulus Materials and Apparatus

All subjects were presented with the same sets of sentences for each paired-associate (P-A) list. Each sentence consisted of a stimulus-response pair of high-imagery nouns selected from the Kroll et al. (1986) as well as McDaniel and Einstein (1986) studies. And each P-A list contained a total of 26 such arranged sentences, with 13 normal and 13 bizarre statements comprising the mixed list.

More specifically, the unmixed normal list contained the following 26 interactive noun pairs: refrigerator-table, burglar-necklace, airplane-tree, spoon-cup, teacher-desk, mop-pail, pencil-calculator,

farmer-tomatoes, policeman-wall, trout-canoe, baby-rattle, dog-frisbee, baseball-window, carpenter-shed, biscuits-oven, microphone-drum, jacket-bed, waiter-necktie, cockroach-stove, coffee-sponge, surfboard-door, queen-locket, doctor-telephone, goldfish-bowl, ant-comb, and cat-fireplace. Likewise, the unmixed bizarre list contained the following high-imagery items: grass-feet, mosquito-camper, ballerina-cake, flashlight-violin, waterfall-balloon, automobile-umbrella, boy-flag, lobster-barrel, painting-rabbit, minister-bible, canary-hairpin, hay-horse, envelope-earrings, cabin-volcano, biologist-microscope, elephant-tuba, sandals-bell, caterpillars-kits, coconuts-shirts, clock-wine, spider-plant, king-glacier, beaver-vest, skyscraper-broom, newspaper-soldier, and chimp-rope. Finally, the mixed list was composed of the 13 normal interacting pairs: professor-chalkboard, pineapple-knife, baker-glasses, eggs-napkin, cookie-counter, star-owl, doughnuts-floor, ocean-tower, magazine-apple, eagle-fencepost, captain-crew, key-box, and candle-church; as well as the 13 bizarre pairs: bicycle-house, butterfly-coin, boulder-frog, cow-billboard, rose-tuxedo, crate-chair, grapes-artist, bottle-piano, tulip-

shampoo, goldfish-sofa, feather-plumber, train-strawberries, and arsonist-fire (refer to Iaccino, Dvorak, & Coler, 1988 further for sentence examples). It should be noted that previous experimental subjects had, in fact, rated all these bizarre elements as significantly more "unusual or atypical" than the common pairs.

Lafayette Company's "Old Reliable" Memory Drum (Model No. 23010) presented these typed materials at the forced experimenter pace of four-second intervals; the drum motor was shut off when subjects were allowed to pace themselves. Further, an electronic stopwatch (Lafayette Model No. 14705XP) which was clearly visible measured subjects' image formation times on the materials to approximately 1/100th of a second.

Procedure

Subjects were tested individually and initially told that the purpose of the experiment was to study individual differences in imagery ability; however, they were not led to believe that there would be a recall test on the items shown, ensuring that any learning would be of an incidental type. Each subject was then informed that for each sentence presented via

the memory drum, they would have to form an interactive mental image of the two capitalized high-imagery nouns either within a four-second period or at their own pace. Immediately following each test trial, subjects were required to rate the vividness of their image on a 5-point scale, with 1 representing no image present to 5 representing the greatest image clarity. Though subjects in the self-paced condition had as much time to form their images and rate them, they were made aware of the fact that their processing time for each sentence was being recorded with a stopwatch, similar to ones in the experimenter-paced condition.

Each subject received a randomized order of the unmixed normal, unmixed bizarre, and mixed P-A lists. A three-minute distractor task was once more employed between list presentations to prevent rehearsal of items as well as reduce interference effects; specifically, the assignment required subjects to count backwards by threes starting with the three-digit number, 297. Afterwards, one of two procedures occurred: either each subject was tested immediately on the list materials that were just displayed or the subject was directed to observe the items presented in the next list.

Each subject who participated in the immediate recall condition for each list received a cued-test sheet containing one of the capitalized nouns from each sentence. Half of the 26 noun cues involved the stimulus terms while the remaining cues involved the response terms. Each subject was asked to recall the noun that had been associated with the provided one within a 15-second interval (which was regarded by subjects to be more than sufficient time to recall the missing element of each noun pair).

Subjects who were not given the immediate cued recall task were requested to come back one-week later for more list presentations. A similar test procedure was used when each subject returned to the laboratory. All of these latter individuals did not expect a recall test and were (to say the least) mildly surprised, signifying that an incidental learning paradigm truly had been established. Upon recall completion, the experimenter revealed the true nature of the study and asked those who participated not to inform other students about the surprise tests.

The number of correct terms for each list was recorded, with synonyms being treated equally accurate,

and then incorporated into the overall 2 (pace) X 2 (delay) X 3 (context) factorial design. Image formation times as well as vividness ratings were also analyzed to further assess the effectiveness of bizarre imagery on performance.

Results

Vividness Ratings. Consistent with our previous findings (Iaccino, Dvorak, & Coler, 1988), an analysis of the vividness ratings indicated that images formed from the common sentences had greater clarity ($M = 4.38$, $SD = 1.07$) than those derived from the bizarre statements ($M = 2.46$, $SD = 1.52$). The context in which the materials were presented (i.e., whether mixed or unmixed) had no discernible effect on these image ratings ($F < 1$). The factor which did contribute to the vividness difference was presentation pace, with a forced pace significantly separating the two image values ($M = 4.12$, $SD = 1.12$ for normal and $M = 1.26$, $SD = 2.26$ for bizarre respectively) and a self-paced schedule equating the two images in vividness, with $M = 4.64$, $SD = .76$ for normal types and $M = 3.66$, $SD = 1.57$ for bizarre. This interaction between presentation pace and imagery type was highly significant, $F(1, 37) =$

13.14, $MSe = .86$, $p < .01$.

Image Formation Times. To examine the amount of time necessary to construct the bizarre and normal images, a mixed factorial ANOVA was performed on subjects' total processing time across contexts and presentation paces (It should be remembered that processing time was determined by how long subjects took to image and rate all 26 sentences in each list). An interaction was clearly evidenced between context and pace, $F(1, 37) = 6.53$, $MSe = 314.00$, $p < .05$. Subsequent Newman-Keuls analyses revealed that when a forced pace was employed, subjects took less time to form their images in the unmixed normal list condition ($M = 152.6$ s) than in the unmixed bizarre ($M = 242.8$ s) and mixed contexts ($M = 210.0$ s), replicating the McDaniel and Einstein (1986) results. When subjects were allowed to proceed at their own pace, however (which rarely exceeded 12.5 s total processing time for each sentence), mixed images were formed just as quickly as unmixed normal types, $Ms = 228.4$ s and 212.6 s respectively, while the unmixed bizarre ones took the longest to form ($M = 275.1$ s). Apparently the forced experimental pace was not of a sufficient duration for subjects to effectively process

the bizarre elements while a self-paced rate was, especially for items within a mixed context. Whether this increased processing time for the mixed elements improved recall performance or not was addressed by the major factorial analysis on number of items correctly recalled.

Recall. The 2 X 2 X 3 design found main effects for context, delay, and presentation pace, with $F(1, 37) = 10.44$, $MSe = .54$, $p < .01$; $F(1, 37) = 9.12$, $MSe = .54$, $p < .01$; and $F(1, 37) = 6.14$, $MSe = .54$, $p < .05$, respectively. Moreover, significant two-way interactions occurred between context X delay, $F(1, 37) = 12.50$, $MSe = 1.32$, $p < .01$ as well as context X pace, $F(1, 37) = 7.94$, $MSe = 1.32$, $p < .01$. Most importantly, the predicted context X delay X pace interaction was highly significant, $F(1, 37) = 11.63$, $MSe = .98$, $p < .01$, confirming our major hypothesis that recall of bizarre elements would be influenced by a combination of all three factors.

Insert Table 1 about here

As Table 1 shows, materials that most benefitted

immediate recall were: unmixed normal list items under both forced pace ($\underline{M}$ = 20.45, $\underline{SD}$ = 1.11) and self-paced conditions ($\underline{M}$ = 19.82, $\underline{SD}$ = .93) as well as mixed elements in the latter condition ($\underline{M}$ = 20.55, $\underline{SD}$ = 1.88). Items from the unmixed bizarre list generated the worst performance, especially with self-pacing ($\underline{M}$ = 17.48, $\underline{SD}$ = 2.46). Also, as partially hypothesized, materials that most benefitted delayed recall, regardless of presentation pace, were mixed elements. And though delay affected retention of all lists adversely (especially the unmixed bizarre list under self-pacing), almost all of the nouns correctly recalled in the mixed list involved the bizarre statements for both forced and self-paced presentation rates, with respective means 9.20 and 7.99.

It would appear that subjects were able to retain a significantly greater portion of bizarre materials on a short-term basis when a) the list was mixed with more normal pairs and b) the pacing was self-controlled. With long-term retention, however, presentation pace did not matter, only the context in which the materials were embedded.

Discussion

To summarize the major findings, a self-paced presentation rate had a positive impact on the vividness ratings of subject images, the formation times of these images- especially with the mixed elements, as well as the immediate recall of these noun pairs. Clearly these predicted results are inconsistent with ones (McDaniel & Einstein, Experiments 3 & 4, 1986) that did not discover a presentation rate difference. However, the rates that were compared in these previous studies all involved durations greater than our interval of 4-seconds. It might be that a critical presentation pace exists, at least on a short-term recall basis, for bizarre imagery to be mnemonically effective; namely, shorter experimental presentations (approximately in the vicinity of 4-seconds) do not help subjects process the inputs as adequately as self-paced schedules while longer rates (of 7-seconds and beyond) allow subjects sufficient processing time that any self-paced rate cannot contribute further to. Definitely this critical experimental period between 4- and 7-seconds needs to be more thoroughly investigated with bizarre materials

before any other conclusions can be derived.

. Another significant finding of ours was that time of testing had a definite influence on the recall performance of the mixed items. In fact, regardless of the presentation pace, a delayed recall period of just one-week was sufficient time for subjects to benefit from a context of mixed materials. This effect was quite consistent with the O'Brien and Wolford (1982) view that bizarre images were less susceptible to interfering events over time. We should, however, qualify the type of image that was retained. Though derived from a bizarre interaction of noun pairs, the image's truly "distinctive" nature was a result of it being offset by more commonplace elements within the initial learning context. Apparently when bizarre items did not have this contrasting surround, performance was poorer- even at lengthy retention intervals. As Jacoby and Craik (1979) have indicated, the context the materials are presented in has an effect on their encoding, and this is well documented in the bizarre imagery research (McDaniel & Einstein, 1986), especially the interaction between context and delay (Iaccino, Dvorak, & Coler, 1988).

One effect that has repeatedly occurred in our

experiments over the years has been that bizarre imagery has improved memory whenever an incidental learning, cued-recall paradigm has been executed. Not all researchers have found this to be the case (Wollen & Cox, 1981b), even when they have employed similar retention intervals (Kroll et al., 1986). The degree of element interaction has been considered by these experimenters to be the determining factor in cued recall performance. Yet, it should be pointed out that context of the stimulus materials was not controlled for in these studies. Further, we used the exact interactive materials as Kroll et al. (1986) and still obtained significant effects with bizarreness on all three of our factors! One, therefore, should not rule out the mnemonic effectiveness of bizarre imagery with this type of learning-recall procedure until other factors have been more thoroughly examined (such as context or presentation pace).

Two negative findings with pace were of interest to these investigators. First, presentation pace did not influence delayed recall performance on the mixed items. It might be that pace only has immediate benefits, and a lengthier processing time between learning and

subsequent recall is the necessary ingredient for the long-term retention of such items. Second, though performance was generally worse for unmixed bizarre elements under both recall periods, the experimental pace did not contribute to a greater decline as hypothesized. If anything, self-pacing affected performance adversely, possibly suggesting that these inputs could not be effectively processed by any presentation schedule employed (including one's own). And the extremely long image formation times with self-pacing ($M = 275.1$ s) would tend to support this argument of ours. As stated previously, more studies need to look at the effect of presentation pace on the recall of bizarre elements within mixed contexts, seeing that this variable did exert some significant (as well as insignificant) influences in the research.

In conclusion, bizarre imagery would seem to be a very effective mnemonic aid on immediate recall when materials are mixed and when the pacing is self-controlled. However, if long-term retention of these inputs is required, the learning context is the all important ingredient on performance. These results have direct applicability to the learning of classroom

materials, especially the way the information is presented and its relation to other referred to topics. Again, these experimental findings are quite consonant with the highly successful "bizarre situation in everyday setting" formulas employed by noted writers and producers (e.g., Stephen King and Stephen Spielberg), and so we recommend that a more appropriate correlation be made between these types of media and those instructional resources used in the classroom. In this way, audio-visual aids can be even more efficient learning tools than they currently are. One precaution that deserves mentioning is that the bizarre materials include for the most part positive affective interactions. We would not want to generate too many negative emotions within our students by the selection of inappropriate items.

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Table 1

Mean Number of Correct Terms Recalled as a Function
of Context, Delay, and Presentation Pace

		Delay	
		3-min	1-week
Pace			
4-sec	Normal	20.45	7.73
	Bizarre	16.17	6.89
	Mixed	17.62	10.43
Self	Normal	19.82	7.18
	Bizarre	17.48	5.42
	Mixed	20.55	9.37

Note. Maximum possible number of correct terms recalled for each list = 26.00.